Semiconsoft,Inc

Thin Film Measurement solution
Software, sensors, custom development
and integration

Accurate Measurement on Thick Polymers on Metal

Measurement of thick polymers with spectroscopic reflectometry is easy. The standard approach is to use a thick –film algorithm based on Fourier transform (FFT) of the spectrum to determine the thickness. This method is convenient to use in production environment because it does not require accurate physical model or calibration. The accuracy of the FFT increases with the number of periods and points in the spectrum. For a given wavelength range, the relative accuracy/resolution increases with increase of the film thickness.

In some cases, the accuracy /resolution of the FFT is not enough for application requirements. The challenge is to improve the accuracy but without complex model and with minimal calibration requirements. Fig. 1 shows an example of measured reflectance spectra of ~ 10 μm photoresist (NR9-6000P) on stainless steel measured with MProbe VisHR system. Using FFT quickly gives the thickness result (Fig. 2). However, the thickness is the same for all points. (see Fig. 3).

It can be seen, from the reflectance spectra, that there is some variation in thickness. So, it appears that FFT approach does not have enough resolution to detect the difference between the thicknesses in the measured points.

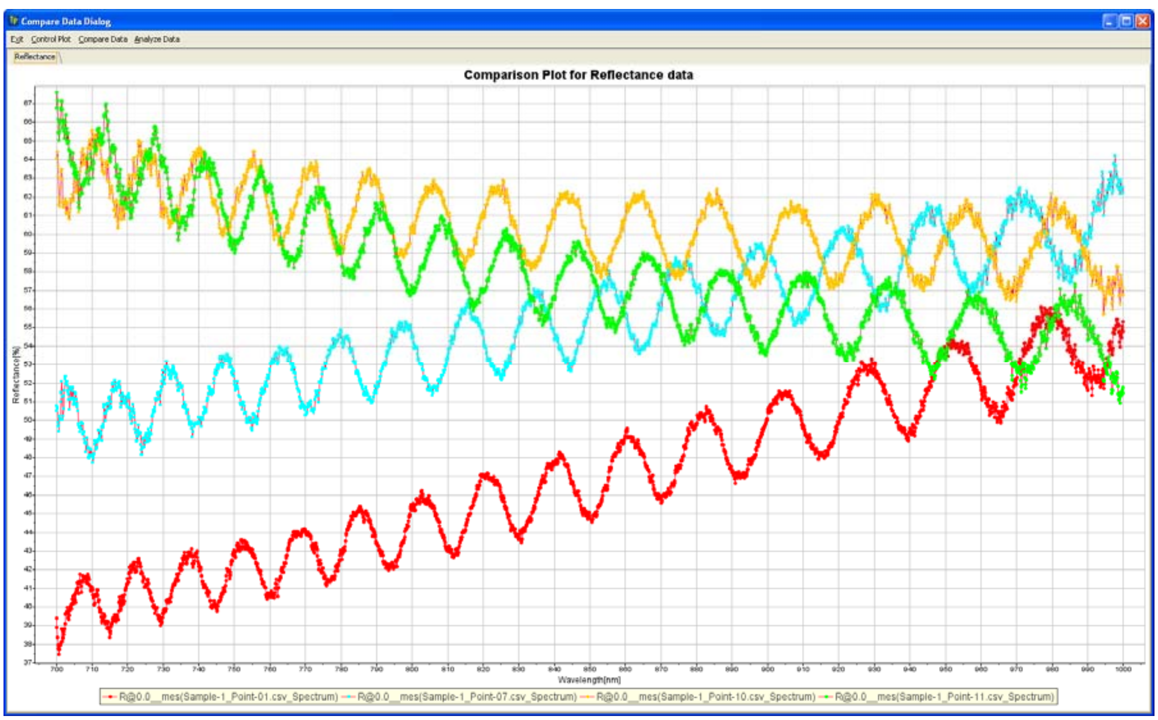

Fig.1. Measured spectra of the photoresist (NR9-6000P) on stainless steel.

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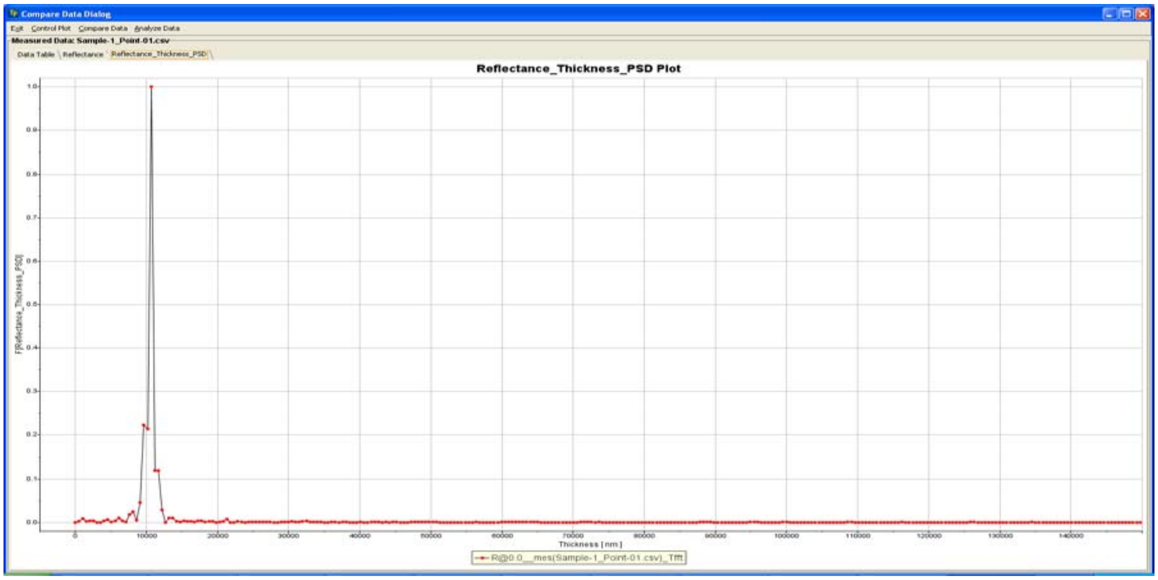

Fig. 2 Results of the data analysis – the position of the pick indicates the thickness of the layer

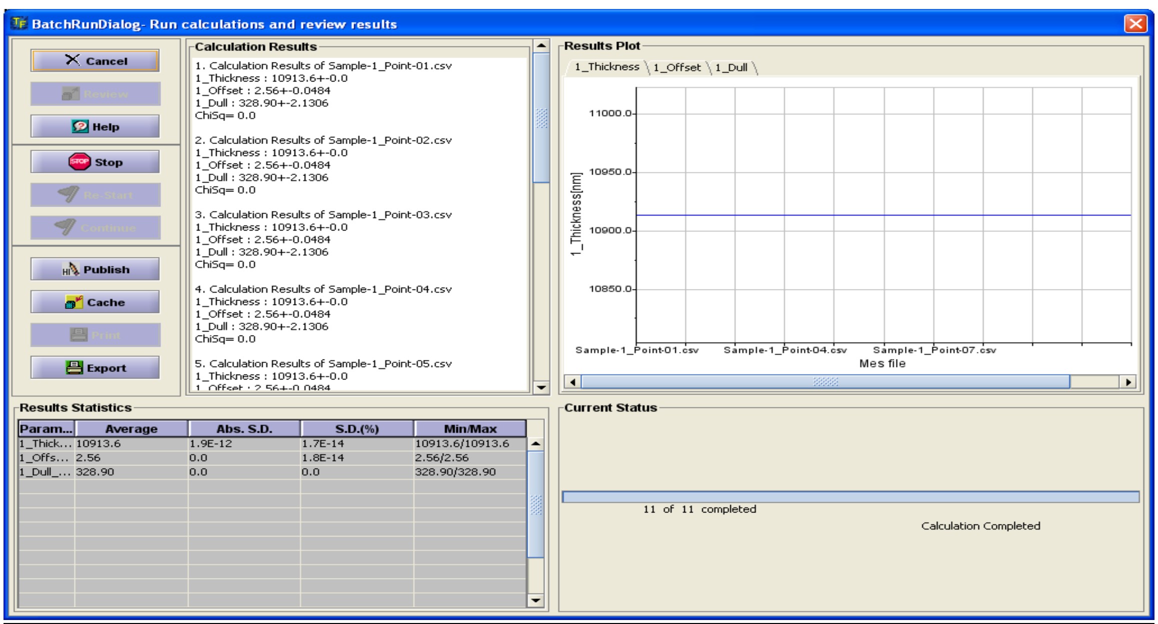

Fig. 3. Results of the data analysis using FFT shows that the thicknesses in all measured points is identical. There is no enough resolution to detect the difference in thicknesses.

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In order to improve the thicknesses measurement accuracy we can try to use a curve fitting algorithm (Marquardt-Levenberg). There are at least two problems with the measured data: measured data has different trends due to the stainless steel thermal treatment and the steel interface is "dull" due to macro-roughness. To correct the fit for this factors without complicating the model, TFCompanion software use "trend remover" and two additional correction factors: "dullness" coefficient and offset factor.

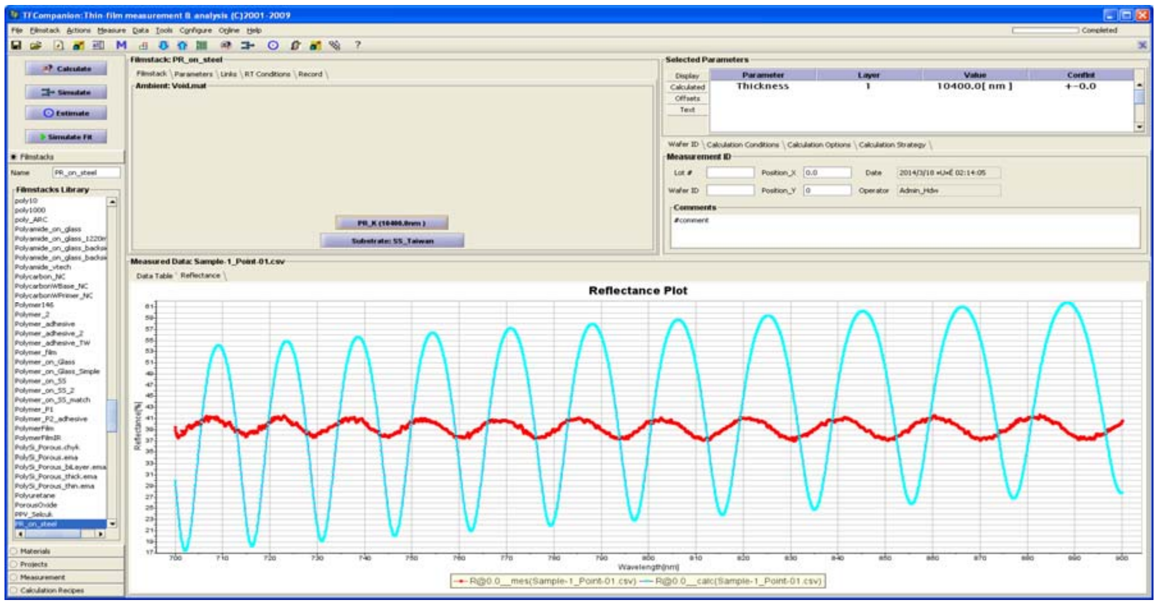

Fig. 4. Model to measured data fit without use of the "dullness" factor. Model spectrum (blue) has much higher amplitude of oscillations that assume standard clean interface.

Using thickness, "dullness" and "offset" factors as measured parameters one can get a good fit to the measured data and a stable model with minimum calibration requirements (Fig. 5)

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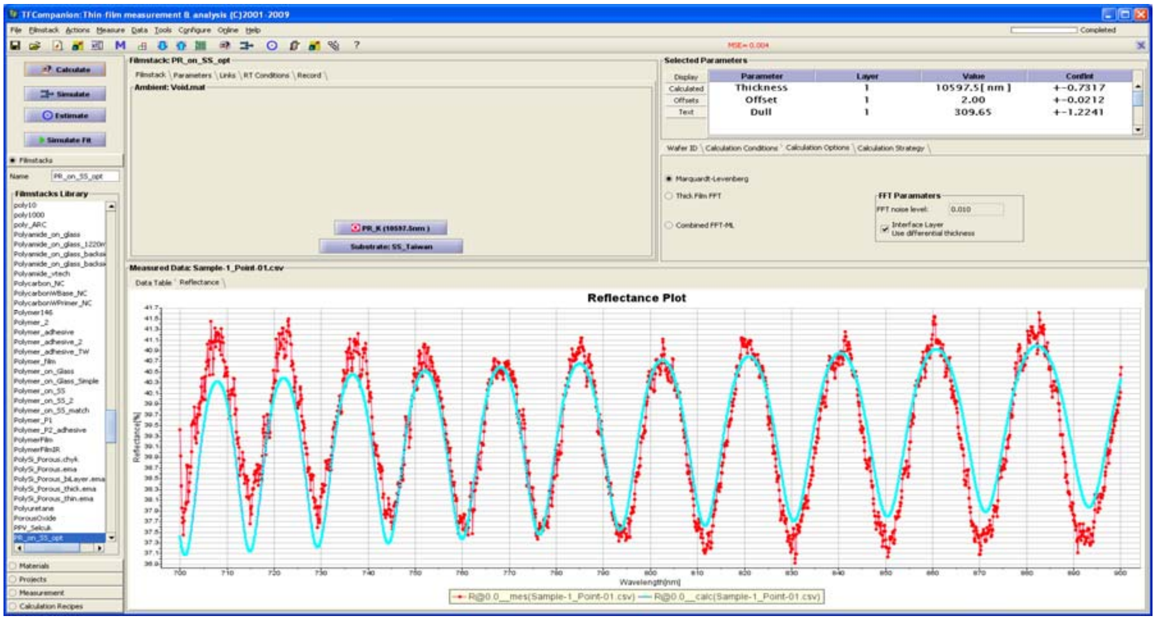

Fig. 5. Fit of the model to measured data using "offset" and "dullness" correction factors. The confidence interval of the thickness value is ±0.8nm (~ ±0.01%)

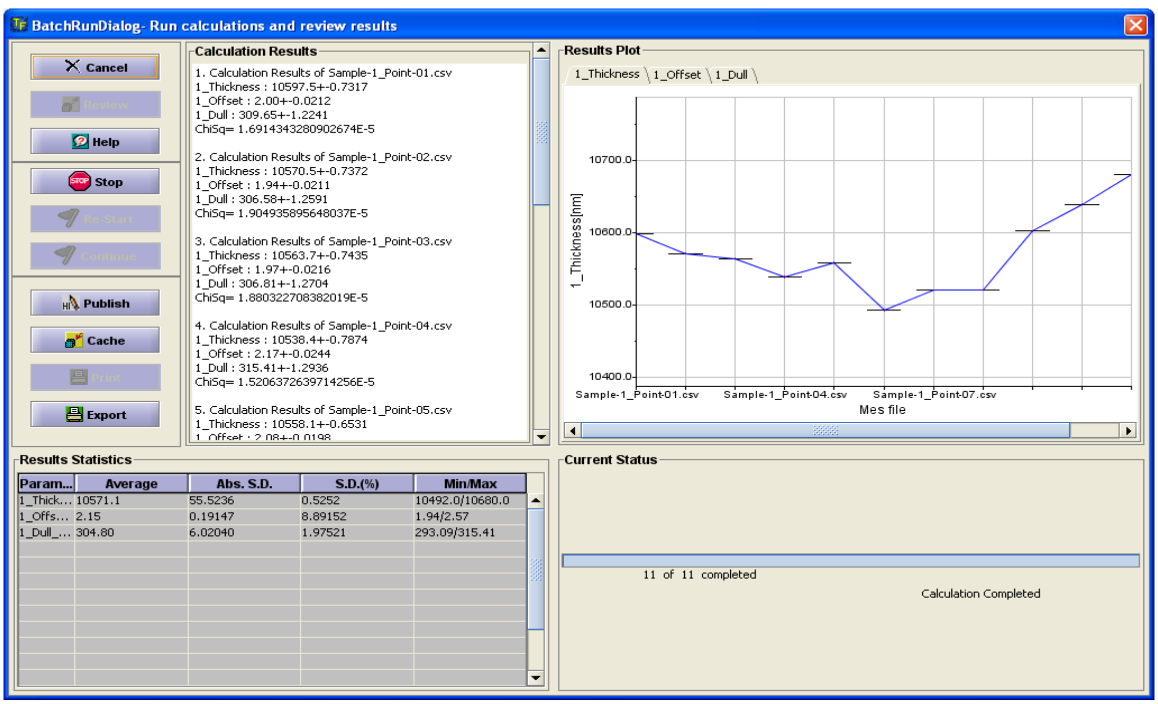

Fig. 6. Results of the data analysis using modified model (as on Fig. 5). Results show variation of the thickness in ~ 180nm range.

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